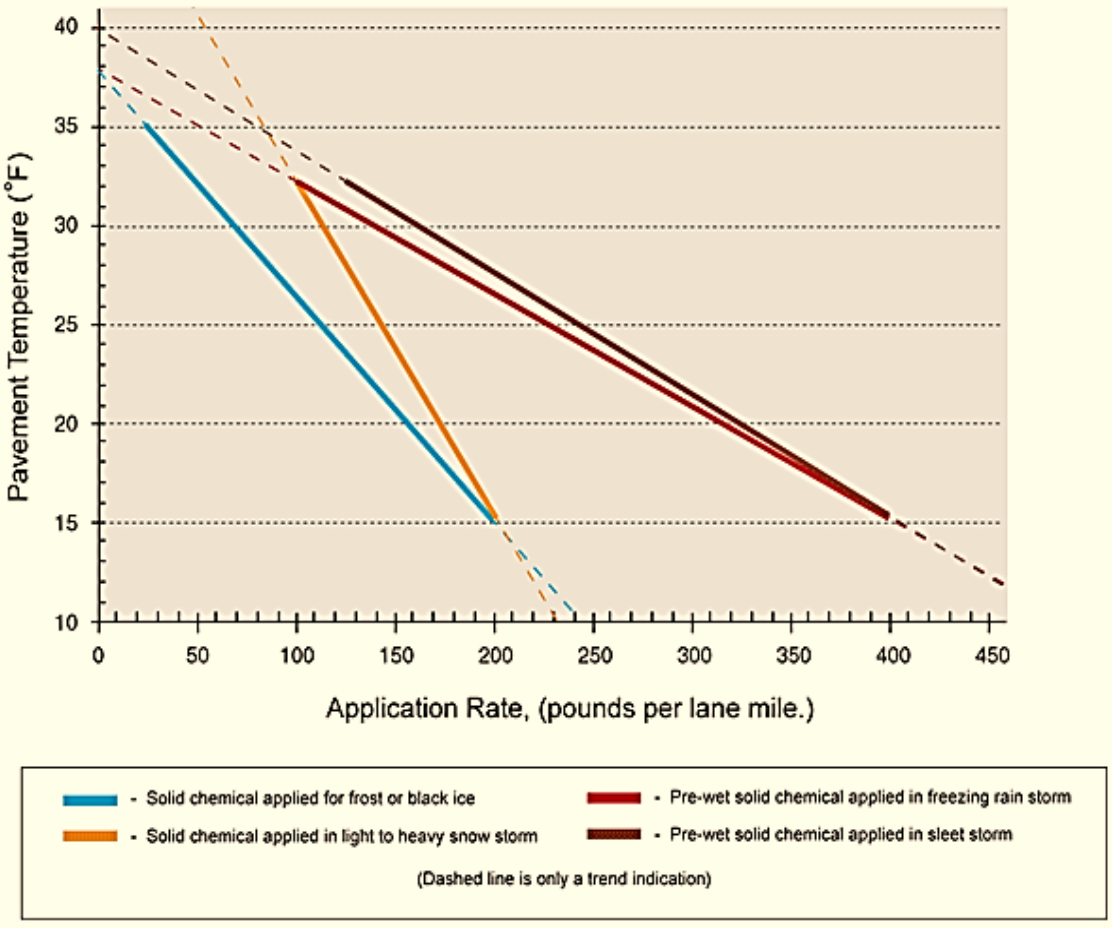
Chapter 6

Application Guidelines

(Based on the FHWA Manual of Practice for an Effective Anti-icing Program)

Recommended Application Rates for Anti-Icing Using Solids
(from FHWA: MANUAL OF PRACTICE FOR AN EFFECTIVE ANTI-ICING PROGRAM)



MATERIAL APPLICATION GUIDELINES

1. INTRODUCTON

The following material application guidelines are intended to complement WSDOT region and area application guidelines which better represent practices unique to their own geographical location. These guidelines may serve as a basis for such local guidelines, or be used in kind to support decision-making and best management practices of a systematic anti-icing program. Local application guidelines which have regional management concurrence should always take precedence.

The department is also committed to reducing corrosion and maximizing the performance characteristics of solid material. Towards that end, the statewide standard application for solid material will be to pre-wet solid material with a minimum of 10 gallons of corrosion inhibited liquid anti-icer. A higher concentration of liquid anti-icer in combination with solid material is both allowed and recommended as such applications have been shown to be extremely effective in a variety of road and weather conditions.

This guide is based upon the Federal Highway Administration's (FHWA) "Manual of Practice for an Effective anti-icing Program" and the "National Cooperative Highway Research Program" (NCHRP) 6-13. The Manual of Practice for an Effective anti-icing Program provides the results of four years of anti-icing field-testing conducted by 15 State highway agencies and supported by the Strategic Highway Research Program (SHRP) and the Federal Highway Administration (FHWA). This guide also uses information obtained from the National Cooperative Highway Research Program (NCHRP) 6-13. Both manuals provide application rates for Sodium Chloride (NaCl). This Guide has been prepared to show equivalent material application rates for Calcium Chloride ($CaCl_2$), Magnesium Chloride ($MgCl_2$), and Calcium Magnesium Acetate (CMA)

2. GUIDANCE FOR ANTI-ICING OPERATIONS

Guidance for anti-icing operations is presented in Tables 1 to 6 for six distinctive winter weather events. The six events are:

1. Light Snow Storm
2. Light Snow Storm with Period(s) of Moderate or Heavy Snow
3. Moderate or Heavy Snow Storm
4. Frost or Black Ice
5. Freezing Rain Storm
6. Sleet Storm

The tables suggest appropriate maintenance actions to take during either an initial or subsequent (follow-up) anti-icing operation for a given weather event. Each action is defined for a range of pavement temperatures and an associated air temperature trend. For some events, the operation is dependent not only on the pavement temperature and trend, but also upon the pavement surface or traffic condition at the time of the anti-icing action. Most of the maintenance actions involve chemical applications in a solid, liquid, or pre-wetted solid form. Application rates or "spread rates" are given for each chemical option to be used appropriately. These are suggested values and should be adjusted, if necessary, to achieve increased effectiveness or efficiency, for local conditions. Application rates in volumetric units (gal/lane-mi) are calculated from dry chemical rates. Comments and notes are given in each table where appropriate to further guide the maintenance field personnel in their anti-icing operations.

3. GLOSSARY OF TERMS

Black Ice: Popular term for a very thin coating of clear, bubble-free, homogeneous ice which forms on a pavement with a temperature at or slightly above 32°F when the temperature of the air in contact with the ground is below the freezing-point of water and small slightly super cooled water droplets deposit on the surface and coalesce (flow together) before freezing.

Freezing Rain: Super cooled droplets of liquid precipitation falling on a surface whose temperature is below or slightly above freezing, resulting in a hard, slick, generally thick coating of ice commonly called glaze or clear ice. Non-super cooled raindrops falling on a surface whose temperature is well below freezing will also result in glaze.

Frost: Also called hoarfrost. Ice crystals in the form of scales, needles, feathers or fans deposited on surfaces cooled by radiation or by other processes. The deposit may be composed of drops of dew frozen after deposition and of ice formed directly from water vapor at a temperature below 32°F (sublimation).

Light Snow: Snow falling at the rate of less than 1/2 inch per hour; visibility is not affected adversely.

Liquid Chemical: A chemical solution; the volume of solution applied per lane mile is the chemical application rate used in this appendix.

Moderate or Heavy Snow: Snow falling at a rate of 1/2 inch per hour or greater; visibility is significantly reduced.

Sleet: A mixture of rain and snow, which has been partially melted by falling through an atmosphere with a temperature slightly above freezing.

Slush: Accumulation of snow, which lies on an impervious base and is saturated with water in excess of its freely drained capacity. It will not support any weight when stepped or driven on but will "squish" until the base support is reached.

Pre-wetting: The practice of applying liquid chemical to dry material before it is placed on the pavement

Dry Chemical Spread Rate. For solid chemical applications, it is simply the weight of the chemical applied per lane mile. For liquid applications it is the amount of liquid chemical applied per lane mile.

Table 1. Weather event: *LIGHT SNOW*

Using a 32% concentration of *Calcium Chloride*

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $CaCl_2$	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $CaCl_2$	N/R=Not Recommended
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM… plow if needed
32°F, or below is imminent;	Dry	Apply liquid	15-35	Plow as needed; reapply liquid Chemical when needed	15-35	*Application rates will depend on dilution potential
ALSO **20 to 32°F,** Remaining in range	Wet, slush, or light snow cover		20-40		20-40	
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		30-65		30-65	* Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

SOLID DEICER: See Sodium Chloride for application recommendations.

Table 2. Weather event: *LIGHT SNOW STORM WITH PERIOD (S) OF MODERATE OR HEAVY SNOW*

Using a 32% concentration of ***Calcium Chloride***

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $CaCl_2$	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $CaCl_2$	N/R=Not Recommended
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM… plow if needed
32°F, or below is imminent;	Dry	Apply liquid	15-35	Plow as needed; reapply liquid Chemical when needed	15-35	*Do not apply liquid chemical onto heavy snow accumulation or packed snow * Application rates will depend on dilution potential
ALSO **20 to 32°F,** Remaining in range	Wet, slush, or light snow cover		20-40		20-40	
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		30-70		30-70	* Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

SOLID DEICER: See Sodium Chloride for application recommendations.

Table 3. Weather event: ***MODERATE OR HEAVY SNOW STORM***

Using a 32% concentration of ***Calcium Chloride***

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $CaCl_2$	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $CaCl_2$	N/R=Not Recommended
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM plow if needed
32°F, or below is imminent;	Dry	Apply pre-wet solid NaCl	N/R	Plow accumulation and reapply pre-wet solid chemical as needed	N/R	* If sufficient moisture is present, solid chemical without pre-wetting can be applied * Do not apply liquid chemical onto heavy snow accumulation or packed snow
ALSO **20 to 32°F,** Remaining in range	Wet, slush, or light snow cover		N/R		N/R	
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		N/R		N/R	
Below 15°F, Steady or falling	Dry or light snow cover	Plow accumulation as needed	N/R	Plow accumulation as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

SOLID DEICER: See Sodium Chloride for application recommendations.

Table 4. Weather event: *FROST OR BLACK ICE*

Using a 32% concentration of *Calcium Chloride*

PAVEMENT TEMPERATURE RANGE, AND TREND	TRAFFIC CONDITION	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
		Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $CaCl_2$	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $CaCl_2$	N/R=Not Recommended
32°F, Steady or rising	Any level	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely; begin treatment if temperature starts to fall to 32°F or below and is at or below dew point
28 to 32°F, Remaining in range or falling 32°F or below, *and* equal to or below dew point	Traffic rate less than 100 vehicles per hour	Apply liquid chemical	10-25	Reapply liquid chemical as needed	10-25	* Application rates will depend on dilution potential
	Traffic rate greater than 100 vehicles per hour		20-35		20-35	
15 to 28°F, Remaining in range, *and* equal to or below dew point	Any level		20-40		25-40	* Application rates will depend on dilution potential
Below 15°F, Steady or falling	Any level	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 5. Weather event: *FREEZING RAINSTORM*

Using a 30% concentration of *Magnesium Chloride*

Using a 32% Calcium *Chloride*

Using a 25% concentration of *CMA*

CHEMICAL APPLICATIONS: It is possible to use these chemicals during this event but is not recommended. However, these products can be used through a pre-wet system to increase solid / abrasive efficacy. The application rate for liquids alone would be cost prohibitive and the potential for dilution is high. It is recommended to use a solid chemical application or abrasives.

Using Solid *Sodium Chloride*

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Chemical spread rate (lb/ln-mi) NaCl	Maintenance Action	Chemical spread rate (lb/ln-mi) NaCl	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	* Monitor pavement temperature closely *Treat icy patches if needed with pre-wetted solid chemical at 100--150 lb/lane-mi
32°F, or below is imminent	Apply solid chemical	100-200	Reapply solid chemical as needed	100-200	*Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
20 to 32°F, Remaining in range		200-300		200-300	
15 to 20°F, Remaining in range		250-400		250-400	
Below 15°F, Steady or falling	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 6. Weather event: ***SLEET STORM***

Using a 32% concentration of ***Calcium Chloride***

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	**Liquid $CaCl_2$**	**Maintenance Action**	**Liquid $CaCl_2$**	**N/R=Not Recommended**
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	Go to Sodium Chloride Chart
32°F, or below is imminent	Apply solid NaCl	N/R	Plow accumulation and reapply pre-wet solid chemical as needed	N/R	
28 to 32°F, Remaining in range					
15 to 28°F, Remaining in range					
Below 15°F, Steady or falling	Plow as needed	N/R	Plow as needed	N/R	

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 1. Weather event: *LIGHT SNOW*

Using a 30% concentration of ***Magnesium Chloride***

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $MgCl_2$	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $MgCl_2$	N/R=Not Recommended
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM… plow if needed
32°F, or below is imminent;	Dry	Apply liquid	15-35	Plow as needed; reapply liquid chemical when needed	15-35	*Application rates will depend on dilution potential
ALSO **20 to 32°F,** Remaining in range	Wet, slush, or light snow cover		20-40		20-40	
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		45-65		45-65	* Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

SOLID DEICER: See Sodium Chloride for application recommendations.

Table 2. Weather event: *LIGHT SNOW STORM WITH PERIOD (S) OF MODERATE OR HEAVY SNOW*

Using a 30% concentration of *Magnesium Chloride*

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $MgCl_2$	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $MgCl_2$	N/R=Not Recommended
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM… plow if needed
32°F, or below is imminent;	Dry	Apply liquid	15-35	Plow as needed; reapply liquid chemical when needed	15-35	
ALSO **20 to 32°F,** Remaining in range	Wet, slush, or light snow cover		20-40		20-40	*Application rates will depend on dilution potential
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		45-70		45-70	* Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

SOLID DEICER: See Sodium Chloride for application recommendations.

Table 3. Weather event: *MODERATE OR HEAVY SNOW STORM*

Using a 30% concentration of ***Magnesium Chloride***

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $MgCl_2$	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $MgCl_2$	N/R=Not Recommended
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM plow if needed
32°F, or below is imminent;	Dry	Apply pre-wet solid NaCl	N/R	Plow accumulation and reapply pre-wet solid chemical as needed	N/R	* If sufficient moisture is present, solid chemical without pre-wetting can be applied * Do not apply liquid chemical onto heavy snow accumulation or packed snow
ALSO **20 to 32°F,** Remaining in range	Wet, slush, or light snow cover		N/R		N/R	
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		N/R		N/R	
Below 15°F, Steady or falling	Dry or light snow cover	Plow accumulation as needed	N/R	Plow accumulation as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

SOLID DEICER: See Sodium Chloride for application recommendations.

Table 4. Weather event: *FROST OR BLACK ICE*

Using a 30% concentration of *Magnesium Chloride*

PAVEMENT TEMPERATURE RANGE, TREND	TRAFFIC CONDITION	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
		Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $MgCl_2$	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid $MgCl_2$	N/R=Not Recommended
32°F, Steady or rising	Any level	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely; begin treatment if temperature starts to fall to 32°F or below and is at or below dew point
28 to 32°F, Remaining in range or falling 32°F or below, *and* equal to or below dew point	Traffic rate less than 100 vehicles per hour	Apply liquid chemical	15-35	Reapply liquid chemical as needed	15-30	* Application rates will depend on dilution potential
	Traffic rate greater than 100 vehicles per hour		20-35		20-35	
15 to 28°F, Remaining in range, *and* equal to or below dew point	Any level		25-40		25-40	* Application rates will depend on dilution potential
Below 15°F, Steady or falling		Apply abrasives as needed	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 5. Weather event: *FREEZING RAINSTORM*

Using a 30% concentration of *Magnesium Chloride*

Using a 32% concentration of *Calcium Chloride*

Using a 25% concentration of *CMA*

CHEMICAL APPLICATIONS: It is possible to use these chemicals during this event but is not recommended. However, these products can be used through a pre-wet system to increase solid / abrasive efficacy. The application rate for liquids alone would be cost prohibitive and the potential for dilution is high. It is recommended to use a solid chemical application or abrasives.

Using Solid *Sodium Chloride*

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Chemical spread rate (lb/ln-mi) NaCl	Maintenance Action	Chemical spread rate (lb/ln-mi) NaCl	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	* Monitor pavement temperature closely *Treat icy patches if needed with pre-wetted solid chemical at 100--150 lb/lane-mi
32°F, or below is imminent	Apply solid chemical	100-200	Reapply solid chemical as needed	100-200	*Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
20 to 32°F, Remaining in range		200-300		200-300	
15 to 20°F, Remaining in range		250-400		250-400	
Below 15°F, Steady or falling	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 6. Weather event: ***SLEET STORM***

Using a 30% concentration of ***Magnesium Chloride***

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Liquid $MgCl_2$	Maintenance Action	Liquid $MgCl_2$	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	Go to Sodium Chloride Chart
32°F, or below is imminent	Apply solid NaCl	N/R	Plow accumulation and reapply pre-wet solid chemical as needed	N/R	
28 to 32°F, Remaining in range					
15 to 28°F, Remaining in range					
Below 15°F, Steady or falling	Plow as needed	N/R	Plow as needed	N/R	

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 1. Weather event: *LIGHT SNOW*

Using a 23% concentration of ***Sodium Chloride***

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of Initial operation	Maintenance action	Chemical spread rate (gal/ln-mi or lb/ln-mi)		Maintenance action	Chemical spread rate (gal/ln-mi or lb/ln-mi)		N/R=Not Recommended
			Liquid NaCl	Solid or pre-wet solid (lb)		Liquid NaCl	Solid or pre-wet solid (lb)	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 100 lb/lane-mi; plow if needed
32°F, or below is imminent;	Dry	Apply liquid or pre-wet solid chemical	40-50	75-125	Plow as needed; reapply liquid or solid chemical when needed	40-50	75-125	*Application rates will depend on dilution potential
ALSO **20 to 32°F,** Remaining in range	Wet, slush, or light snow cover	Apply liquid or solid chemical	40-90	100-210		40-90	100-210	
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover	Apply pre-wet solid chemical	N/R	200-240	Plow as needed; reapply pre-wet solid chemical when needed	N/R	200-240	*If sufficient moisture is present, solid chemical without pre-wetting can be applied *Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 2. Weather event: *LIGHT SNOW STORM WITH PERIOD (S) OF MODERATE OR HEAVY SNOW*

Using a 23% concentration of ***Sodium Chloride***

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS					COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/ln-mi or lb/ln-mi)		Maintenance Action	Chemical spread rate (gal/ln-mi or lb/ln-mi)				N/R=Not Recommended
			Liquid **NaCl**	Solid or pre-wet Solid		Liquid **NaCl**		Solid or pre-wet solid		
						Light snow	Heavier snow	Light snow	Heavier snow	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R				*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 40-65 GPLM; plow if needed
32°F, or below is imminent;	Dry	Apply liquid or pre-wet solid chemical	40-65	75-150	Plow as needed; reapply liquid or solid chemical when needed	40-50	50-65	75-125	150-200	*Do not apply liquid chemical onto heavy snow accumulation or packed snow * Application rates will depend on dilution potential
ALSO **25 to 32°F**, Remaining in range	Wet, slush, or light snow cover	Apply liquid or solid chemical	65-90	175-200		65-80	80-90	175-185	190-200	
15 to 25°F, Remaining in range	Dry, wet, slush, or light snow cover	Apply pre-wet solid chemical	N/R	200-230	Plow as needed; reapply pre-wet solid chemical when needed	N/R		200-230	200-250	* If sufficient moisture is present, solid chemical without pre-wetting can be applied * Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R				* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 3. Weather event: *MODERATE OR HEAVY SNOW STORM*

Using a 23% concentration of ***Sodium Chloride***

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/ln-mi or lb/ln-mi)		Maintenance Action	Chemical spread rate (gal/ln-mi or lb/ln-mi)		N/R=Not Recommended
			Liquid **NaCl**	Solid or pre-wet Solid		Liquid **NaCl**	Solid or pre-wet solid	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 40-65 GPLM; plow if needed
32° F, or below is imminent;	Dry	Apply liquid or pre-wet solid chemical	40-65	75-150	Plow accumulation and reapply liquid or pre-wet solid chemical as needed	50-65	150-200	*Do not apply liquid chemical onto heavy snow accumulation or packed snow * Application rates will depend on dilution potential
ALSO **25 to 32°F**, Remaining in range	Wet, slush, or light snow cover	Apply solid chemical	N/R	175-200	Plow accumulation and reapply pre-wet solid chemical as needed	80-90	190-200	
15 to 25°F, Remaining in range	Dry, wet, slush, or light snow cover	Apply pre-wet solid chemical	N/R	200-230	Plow as needed; reapply pre-wet solid chemical when needed	N/R	200-250	* If sufficient moisture is present, solid chemical without pre-wetting can be applied * Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 4. Weather event: *FROST OR BLACK ICE*

Using a 23% concentration of *Sodium Chloride*

PAVEMENT TEMPERATURE RANGE, TREND	TRAFFIC CONDITION	INITIAL OPERATION			SUBSEQUENT OPERATIONS			COMMENTS
		Maintenance Action	Chemical spread rate (gal/ln-mi or Lb/ln-mi)		Maintenance Action	Chemical spread rate (gal/ln-mi or lb/ln-mi)		N/R=Not Recommended
			Liquid NaCl	Solid or pre-wet solid		Liquid NaCl	Solid or pre-wet solid	
32°F, Steady or rising	Any level	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely; begin treatment if temperature starts to fall to 32°F or below and is at or below dew point
28 to 32°F, Remaining in range or falling 32°F or below, *and* equal to or below dew point	Traffic rate less than 100 vehicles per h	Apply liquid or pre-wet solid chemical	45-60	100-130	Reapply liquid or pre-wet solid chemical when needed	45-60	100-130	* Application rates will depend on dilution potential
	Traffic rate greater than 100 vehicles per h		45-75	100-130		45-75	100-130	
20 to 28°F, Remaining in range, *and* equal to or below dew point	Any level		65-80	165-200		65-80	165-200	* Application rates will depend on dilution potential
15 to 20°F, Remaining in range, *and* equal to or below dew point		Apply pre-wet solid chemical	N/R	175-225	Reapply pre-wet solid chemical when needed	N/R	175-225	
Below 15°F, Steady or falling		Apply abrasives	N/R		Apply abrasives as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 5. Weather event: *FREEZING RAINSTORM*

Using a 30% concentration of *Magnesium Chloride*

Using a 32% concentration of *Calcium Chloride*

Using a 25% concentration of *CMA*

CHEMICAL APPLICATIONS: It is possible to use these chemicals during this event but is not recommended. However, these products can be used through a pre-wet system to increase solid / abrasive efficacy. The application rate for liquids alone would be cost prohibitive and the potential for dilution is high. It is recommended to use a solid chemical application or abrasives.

Using Solid *Sodium Chloride*

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Chemical spread rate (lb/ln-mi) NaCl	Maintenance Action	Chemical spread rate (lb/ln-mi) NaCl	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	* Monitor pavement temperature closely *Treat icy patches if needed with pre-wetted solid chemical at 100--150 lb/lane-mi
32°F, or below is imminent	Apply solid chemical	100-200	Reapply solid chemical as needed	100-200	*Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
20 to 32°F, Remaining in range		200-300		200-300	
15 to 20°F, Remaining in range		250-400		250-400	
Below 15°F, Steady or falling	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 6. Weather event: ***SLEET STORM***

Using a 23% concentration of ***Sodium Chloride***

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	**Chemical spread rate, lb/lane-mi NaCl**	**Maintenance Action**	**Chemical spread rate, lb/lane-mi NaCl**	**N/R=Not Recommended**
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	* Monitor pavement temperature closely *Treat icy patches if needed with pre-wetted solid chemical at 100-150 lb/lane-mi
32°F, or below is imminent	Apply solid chemical	125	Plow accumulation and reapply pre-wet solid chemical as needed	125	*Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
28 to 32°F, Remaining in range		125-325		125-325	
15 to 28°F, Remaining in range		250-400		250-400	
Below 15°F, Steady or falling	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.